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NOTICE OF ALLOWANCE AND FEE(S) DUE

00909 7590 04/02/2004

PILLSBURY WINTHROP, LLP
P.O. BOX 10500
MCLEAN, VA 22102

EXAMINER	
ASSAF, FAYEZ G	
ART UNIT	**PAPER NUMBER**
2872	

DATE MAILED: 04/02/2004

APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/674,489	10/01/2003	Tohru Nakamura	061069-0305769	4671

TITLE OF INVENTION: OBSERVATION OPTICAL SYSTEM USING VOLUME HOLOGRAM

APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1330	$300	$1630	07/02/2004

THE APPLICATION IDENTIFIED ABOVE HAS BEEN EXAMINED AND IS ALLOWED FOR ISSUANCE AS A PATENT. PROSECUTION ON THE MERITS IS CLOSED. THIS NOTICE OF ALLOWANCE IS NOT A GRANT OF PATENT RIGHTS. THIS APPLICATION IS SUBJECT TO WITHDRAWAL FROM ISSUE AT THE INITIATIVE OF THE OFFICE OR UPON PETITION BY THE APPLICANT. SEE 37 CFR 1.313 AND MPEP 1308.

THE ISSUE FEE AND PUBLICATION FEE (IF REQUIRED) MUST BE PAID WITHIN THREE MONTHS FROM THE MAILING DATE OF THIS NOTICE OR THIS APPLICATION SHALL BE REGARDED AS ABANDONED. THIS STATUTORY PERIOD CANNOT BE EXTENDED. SEE 35 U.S.C. 151. THE ISSUE FEE DUE INDICATED ABOVE REFLECTS A CREDIT FOR ANY PREVIOUSLY PAID ISSUE FEE APPLIED IN THIS APPLICATION. THE PTOL-85B (OR AN EQUIVALENT) MUST BE RETURNED WITHIN THIS PERIOD EVEN IF NO FEE IS DUE OR THE APPLICATION WILL BE REGARDED AS ABANDONED.

HOW TO REPLY TO THIS NOTICE:

I. Review the SMALL ENTITY status shown above.

If the SMALL ENTITY is shown as YES, verify your current SMALL ENTITY status:
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B. If applicant claimed SMALL ENTITY status before, or is now claiming SMALL ENTITY status, check the box below and enclose the PUBLICATION FEE and 1/2 the ISSUE FEE shown above.

☐ Applicant claims SMALL ENTITY status. See 37 CFR 1.27.

II. PART B - FEE(S) TRANSMITTAL should be completed and returned to the United States Patent and Trademark Office (USPTO) with your ISSUE FEE and PUBLICATION FEE (if required). Even if the fee(s) have already been paid, Part B - Fee(s) Transmittal should be completed and returned. If you are charging the fee(s) to your deposit account, section "4b" of Part B - Fee(s) Transmittal should be completed and an extra copy of the form should be submitted.

III. All communications regarding this application must give the application number. Please direct all communications prior to issuance to Mail Stop ISSUE FEE unless advised to the contrary.

IMPORTANT REMINDER: Utility patents issuing on applications filed on or after Dec. 12, 1980 may require payment of maintenance fees. It is patentee's responsibility to ensure timely payment of maintenance fees when due.

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Complete and send this form, together with applicable fee(s), to: Mail **Mail Stop ISSUE FEE**
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INSTRUCTIONS: This form should be used for transmitting the ISSUE FEE and PUBLICATION FEE (if required). Blocks 1 through 4 should be completed where appropriate. All further correspondence including the Patent, advance orders and notification of maintenance fees will be mailed to the current correspondence address as indicated unless corrected below or directed otherwise in Block 1, by (a) specifying a new correspondence address; and/or (b) indicating a separate "FEE ADDRESS" for maintenance fee notifications.

CURRENT CORRESPONDENCE ADDRESS (Note: Legibly mark-up with any corrections or use Block 1)

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I hereby certify that this Fee(s) Transmittal is being deposited with the United States Postal Service with sufficient postage for first class mail in an envelope addressed to the Mail Stop ISSUE FEE address above, or being facsimile transmitted to the USPTO, on the date indicated below.

(Depositor's name)
(Signature)
(Date)

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APPLN. TYPE	SMALL ENTITY	ISSUE FEE	PUBLICATION FEE	TOTAL FEE(S) DUE	DATE DUE
nonprovisional	NO	$1330	$300	$1630	07/02/2004

EXAMINER	ART UNIT	CLASS-SUBCLASS
ASSAF, FAYEZ G	2872	359-015000

1. Change of correspondence address or indication of "Fee Address" (37 CFR 1.363).

❑ Change of correspondence address (or Change of Correspondence Address form PTO/SB/122) attached.

❑ "Fee Address" indication (or "Fee Address" Indication form PTO/SB/47; Rev 03-02 or more recent) attached. **Use of a Customer Number is required.**

2. For printing on the patent front page, list (1) the names of up to 3 registered patent attorneys or agents OR, alternatively, (2) the name of a single firm (having as a member a registered attorney or agent) and the names of up to 2 registered patent attorneys or agents. If no name is listed, no name will be printed.

1 _____

2 _____

3 _____

3. ASSIGNEE NAME AND RESIDENCE DATA TO BE PRINTED ON THE PATENT (print or type)

PLEASE NOTE: Unless an assignee is identified below, no assignee data will appear on the patent. Inclusion of assignee data is only appropriate when an assignment has been previously submitted to the USPTO or is being submitted under separate cover. Completion of this form is NOT a substitute for filing an assignment.

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Please check the appropriate assignee category or categories (will not be printed on the patent); ❑ individual ❑ corporation or other private group entity ❑ government

4a. The following fee(s) are enclosed:

❑ Issue Fee

❑ Publication Fee

❑ Advance Order - # of Copies _____

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❑ Payment by credit card. Form PTO-2038 is attached.

❑ The Director is hereby authorized by charge the required fee(s), or credit any overpayment, to Deposit Account Number _____ (enclose an extra copy of this form).

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(Authorized Signature) (Date)

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ASSAF, FAYEZ G	

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2872	

DATE MAILED: 04/02/2004

Determination of Patent Term Adjustment under 35 U.S.C. 154 (b)
(application filed on or after May 29, 2000)

The Patent Term Adjustment to date is 0 day(s). If the issue fee is paid on the date that is three months after the mailing date of this notice and the patent issues on the Tuesday before the date that is 28 weeks (six and a half months) after the mailing date of this notice, the Patent Term Adjustment will be 0 day(s).

If a Continued Prosecution Application (CPA) was filed in the above-identified application, the filing date that determines Patent Term Adjustment is the filing date of the most recent CPA.

Applicant will be able to obtain more detailed information by accessing the Patent Application Information Retrieval (PAIR) system (http://pair.uspto.gov).

Any questions regarding the Patent Term Extension or Adjustment determination should be directed to the Office of Patent Legal Administration at (703) 305-1383. Questions relating to issue and publication fee payments should be directed to the Customer Service Center of the Office of Patent Publication at (703) 305-8283.

PTOL-85 (Rev. 11/03) Approved for use through 04/30/2004.

Notice of Allowability	Application No.	Applicant(s)	
	10/674,489	NAKAMURA ET AL.	
	Examiner	Art Unit	
	Fayez G. Assaf	2872	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address--

All claims being allowable, PROSECUTION ON THE MERITS IS (OR REMAINS) CLOSED in this application. If not included herewith (or previously mailed), a Notice of Allowance (PTOL-85) or other appropriate communication will be mailed in due course. **THIS NOTICE OF ALLOWABILITY IS NOT A GRANT OF PATENT RIGHTS.** This application is subject to withdrawal from issue at the initiative of the Office or upon petition by the applicant. See 37 CFR 1.313 and MPEP 1308.

1. ☒ This communication is responsive to *the Divisional Application filed 10/1/03*.

2. ☒ The allowed claim(s) is/are *19-33,35 and 37-39*.

3. ☒ The drawings filed on *01 October 2003* are accepted by the Examiner.

4. ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
   a) ☒ All b) ☐ Some* c) ☐ None of the:
      1. ☐ Certified copies of the priority documents have been received.
      2. ☒ Certified copies of the priority documents have been received in Application No. *09/749,569* .
      3. ☐ Copies of the certified copies of the priority documents have been received in this national stage application from the International Bureau (PCT Rule 17.2(a)).

   * Certified copies not received: _____.

Applicant has THREE MONTHS FROM THE "MAILING DATE" of this communication to file a reply complying with the requirements noted below. Failure to timely comply will result in ABANDONMENT of this application.
THIS THREE-MONTH PERIOD IS NOT EXTENDABLE.

5. ☐ A SUBSTITUTE OATH OR DECLARATION must be submitted. Note the attached EXAMINER'S AMENDMENT or NOTICE OF INFORMAL PATENT APPLICATION (PTO-152) which gives reason(s) why the oath or declaration is deficient.

6. ☐ CORRECTED DRAWINGS (as "replacement sheets") must be submitted.
   (a) ☐ including changes required by the Notice of Draftsperson's Patent Drawing Review (PTO-948) attached
      1) ☐ hereto or 2) ☐ to Paper No./Mail Date _____.
   (b) ☐ including changes required by the attached Examiner's Amendment / Comment or in the Office action of Paper No./Mail Date _____.

   Identifying indicia such as the application number (see 37 CFR 1.84(c)) should be written on the drawings in the front (not the back) of each sheet. Replacement sheet(s) should be labeled as such in the header according to 37 CFR 1.121(d).

7. ☐ DEPOSIT OF and/or INFORMATION about the deposit of BIOLOGICAL MATERIAL must be submitted. Note the attached Examiner's comment regarding REQUIREMENT FOR THE DEPOSIT OF BIOLOGICAL MATERIAL.

Attachment(s)

1. ☒ Notice of References Cited (PTO-892)
2. ☐ Notice of Draftperson's Patent Drawing Review (PTO-948)
3. ☒ Information Disclosure Statements (PTO-1449 or PTO/SB/08), Paper No./Mail Date 10/01/03
4. ☐ Examiner's Comment Regarding Requirement for Deposit of Biological Material
5. ☐ Notice of Informal Patent Application (PTO-152)
6. ☐ Interview Summary (PTO-413), Paper No./Mail Date _____ .
7. ☒ Examiner's Amendment/Comment
8. ☒ Examiner's Statement of Reasons for Allowance
9. ☐ Other _____.

DETAILED ACTION

Examiner's Amendment

An examiner's amendment to the record appears below. Should the changes and/or additions be unacceptable to applicant, an amendment may be filed as provided by 37 CFR 1.312. To ensure consideration of such an amendment, it MUST be submitted no later than the payment of the issue fee.

Authorization for this examiner's amendment was given in a telephone interview with Mr. Henry J. Daley (Reg. No. 42459) on 3/19/2004.

Claims 21 and 22 have been amended to correct typographical errors.

Claim 33 has been amended in order to distinguish over the prior art.

Claims 37-39 have been amended in order to provide proper claim dependency.

The claims have been amended as follows:

Claims 34 and 36 have been cancelled.

21. (Currently Amended) An image observation optical system comprising:

an image display element; and

an eyepiece optical system which introduces an image displayed by said image display element to a center of an eye of an observer without forming an intermediate image, so as to allow the observer to observe said image as a virtual image,

wherein said eyepiece optical system is constructed and arranged to bend an optical axis using reflecting surfaces so as to be compact, said optical axis lying in a plane,

wherein said eyepiece optical system is symmetrically formed with respect to said plane and includes an optical element having an entrance surface, a plurality of curved reflecting surfaces and an exit surface, at least one of said reflecting surfaces being provided with a volume hologram (HOE),

[wherein said eyepiece optical system comprises a prism with a positive refracting power, and, upon an image position F0 at a midpoint, an image position Fb at one end point showing a larger chromatic aberration of magnification, and an image position Fa at another end point showing a smaller chromatic aberration of magnification being defined on a segment that is an intersection formed by said plane of symmetry of said eyepiece optical system and an image display surface, said image

observation optical system satisfies the following conditions simultaneously:

$$-1 < \phi y(\text{HOE, Fa})/\phi y(\text{Total}) < 2$$

$$-1 < \phi y(\text{HOE, Fb})/\phi y(\text{Total}) < 1$$

where ϕy(HOE, Fa) is a y-direction power of said HOE at the image position Fa, ϕy(HOE, Fb) is a y-direction power of said HOE at the image position Fb, and ϕy(Total) is a y-direction power of an entire system,]

wherein said eyepiece optical system is configured as a prism optical system having at least two reflecting surfaces, said HOE has one or two plane of symmetry of power, and said plane of symmetry of said HOE coincides with a plane of symmetry of a shape of a base on which said HOE is provided, and

wherein said prism optical system comprises a prism with a positive refracting power and at least two HOEs between said image display element and an exit pupil, and, upon an image position F0 at a midpoint being defined on a segment that is an intersection displayed by said plane of symmetry of said eyepiece optical system and an image display surface, said image observation optical system satisfies the following condition:

$$| \phi y(\text{HOE, F0})/\phi y(\text{Total}) | < 0.25$$

where ϕy(HOE, F0) is a y-direction power of said HOEs at the image position F0, and ϕy(Total) is a y-direction power of an entire system.

22. (Currently Amended) An image observation optical system comprising:

an image display element; and

an eyepiece optical system which introduces an image displayed by said image display element to a center of an eye of an observer without forming an intermediate image, so as to allow the observer to observe said image as a virtual image,

wherein said eyepiece optical system is constructed and arranged to bend an optical axis using reflecting surfaces so as to be compact, said optical axis lying in a plane,

wherein said eyepiece optical system is symmetrically formed with respect to said plane and includes an optical element having an entrance surface, a plurality of curved reflecting surfaces and an exit surface, at least one of said reflecting surfaces being provided with a volume hologram (HOE),

wherein said eyepiece optical system comprises a prism with a positive refracting power, and, upon an image position F0 at a midpoint, an image position Fb at one end point showing a larger chromatic aberration of magnification, and an image position Fa at another end point showing a smaller chromatic aberration of magnification being defined on a segment that is an intersection formed by said plane of symmetry of said eyepiece optical system and an image display surface, said image observation optical system satisfies the following conditions simultaneously:

$$-1 < \phi y(\text{HOE, Fa})/\phi y(\text{Total}) < 2$$

$$-1 < \phi y(\text{HOE, Fb})/\phi y(\text{Total}) < 1$$

where ϕy(HOE, Fa) is a y-direction power of said HOE at the image position Fa, ϕy(HOE, Fb) is a y-direction power of said HOE at the image position Fb, and ϕy(Total) is a y-direction power of an entire system,

[wherein said eyepiece optical system is configured as a prism optical system having at least two reflecting surfaces, said HOE has one or two plane of symmetry of power, and said plane of symmetry of said HOE coincides with a plane of symmetry of a shape of a base on which said HOE is provided,]

wherein said eyepiece optical system is configured as a prism optical system having at least two reflecting surfaces, said HOE has one or two plane of symmetry of power, and said plane of symmetry of said HOE coincides with a plane of symmetry of a shape of a base on which said HOE is provided, and

wherein said eyepiece optical system comprises at least two HOEs between said image display element and an exit pupil, and said image observation optical system satisfies the following condition:

$$| \phi y(\text{HOE, F0}) / \phi y(\text{Total}) | < 0.25$$

where ϕy(HOE, F0) is a y-direction power of said HOEs at the image position F0, and ϕy(Total) is a y-direction power of an entire system.

33. (Currently Amended) A head-mount type image display apparatus comprising:

a main frame in which an image observation optical system is arranged, and;

a support member which is constructed to be mounted on lateral sides of a head of an observer so as to hold said main frame in front of a face of the observer;

wherein said image observation optical system comprises:

an image display element; and

an eyepiece optical system which introduces an image formed by said image display element to a center of an eye of the observer without forming an intermediate image, so as to allow the observer to observe said image as a virtual image,

wherein said eyepiece optical system is constructed and arranged to bend an optical axis using reflecting surfaces so as to be compact, said optical axis lying in a plane,

wherein said eyepiece optical system is symmetrically formed with respect to said plane and includes an optical element having an entrance surface, a plurality of curved reflecting surfaces and an exit surface, at least one of said reflecting surfaces being provided with a volume hologram (HOE),

wherein said eyepiece optical system comprises a prism with a positive refracting power, and, upon an image position F0 at a midpoint, an image position Fb at one end point showing a larger chromatic aberration of magnification, and an image position Fa at another end point showing a smaller chromatic aberration of magnification being defined on a segment that is an intersection

formed by said plane of symmetry of said eyepiece optical system and an image display surface, said image observation optical system satisfies the following conditions simultaneously:

$$-1 < \phi y(\text{HOE, Fa})/\phi y(\text{Total}) < 2$$

$$-1 < \phi y(\text{HOE, Fb})/\phi y(\text{Total}) < 1$$

where ϕy(HOE, Fa) is a y-direction power of said HOE at the image position Fa, ϕy(HOE, Fb) is a y-direction power of said HOE at the image position Fb, and ϕy(Total) is a y-direction power of an entire system, and

wherein said support member is constructed to achieve removable mount to side frames of spectacles.

37. (Currently Amended) A head-mount type image display apparatus according to claim 33[,] or [34,] 35 [or 36], wherein said image observation optical system and an optical system for spectacles are integrally arranged in said main frame.

38. (Currently Amended) A head-mount type image display apparatus according to claim 33[,] or [34,] 35 [or 36], wherein said support member is constructed to achieve removable mount to side frames of spectacles.

39. (Currently Amended) A head-mount type image display apparatus according to claim 33[,] or [34,] 35 [or 36], wherein a pair of said image observation optical systems are arranged in parallel as left and right systems for providing binocular view.

The Abstract now reads as follows:

An observation optical system comprises an image display element and an eyepiece optical system which introduces an image formed by the image display element to a center of an eye of an observer without forming an intermediate image, so as to allow the observer to observe the image as a virtual image. The eyepiece optical system is constructed and arranged to bend the optical axis using reflecting surfaces so as to be compact. The image observation optical system can be made compact enough to be usable as an image display unit for a cellular phone or a portable intelligent terminal, and can achieve high image definition and wide field angle while controlling chromatic aberration of magnification to be small.

Allowable Subject Matter

Claims 19-32 are allowable over the prior art for at least the reason that the prior art fails to teach or reasonably

suggest the observation optical system satisfying the following condition:

$$| \phi y(\text{HOE, F0}) / \phi y(\text{Total}) | < 0.25$$

where ϕy(HOE, F0) is a y-direction power of said HOEs at the image position F0, and ϕy(Total) is a y-direction power of an entire system as set forth in the claimed combination.

Claims 33, 35 and 37-39 are allowable over the prior art for at least the reason that the prior art fails to teach or reasonably suggest the observation optical system satisfies the following conditions simultaneously:

$$-1 < \phi y(\text{HOE, Fa}) / \phi y(\text{Total}) < 2$$

$$-1 < \phi y(\text{HOE, Fb}) / \phi y(\text{Total}) < 1$$

where ϕy(HOE, Fa) is a y-direction power of said HOE at the image position Fa, ϕy(HOE, Fb) is a y-direction power of said HOE at the image position Fb, and ϕy(Total) is a y-direction power of an entire system as set forth in the claimed combination.

The prior art made of record and not relied upon is considered pertinent to applicant's disclosure.

Mukawa (US 6,331,916 B1): Mukawa discloses an image observation optical system comprising, an image display element (20 of Fig. 11), an eyepiece optical system comprising a prism with a positive refracting power which introduces an image formed by the image display element to a center of an eye of an observer (at 130 of Fig. 11) without forming an intermediate image, so as to allow the observer to observe the image as a virtual image (see Fig. 11), wherein the eyepiece optical system is constructed and arranged to bend an optical axis using reflecting surfaces (32 and 33 of Fig. 11) so as to be compact. The reference does not teach or render obvious the image observation optical system satisfying the conditions recited in each independent claim.

Conclusion

Any inquiry concerning this communication or earlier communications from the examiner should be directed to Fayez G. Assaf whose telephone number is (571) 272-2307. The examiner can normally be reached on 8-5 M-F.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Drew Dunn can be reached on (571) 272-2312. The fax phone number for the

organization where this application or proceeding is assigned is 703-872-9306.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

Fayez Assaf
3/19/04

DREW A. DUNN
SUPERVISORY PATENT EXAMINER